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The Effects of Dams on Climate Change

Brandon Pike

Western Oregon University, bpike14@mail.wou.edu

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The Effects of Dams on Climate Change

Brandon Pike | Western Oregon University

Abstract

Dams play a major role in anthropogenic climate change, and not for the better. The reservoirs behind dams are a substantial and growing source of global methane (CH_4) emissions, leading a number of researchers to question the net benefits of hydroelectric dams in the fight against climate change. Globally, this accounts for around 20 percent of human-caused methane emissions. This process is amplified in areas with large amounts of biomass, such as tropical and other lower-latitude areas where dams are being built at a quick rate (Keitel, Zak, & Hupfer, 2016). As we look for sources of clean and renewable energy to adapt to a changing climate, understanding the pros and cons of hydroelectric dams is crucial.

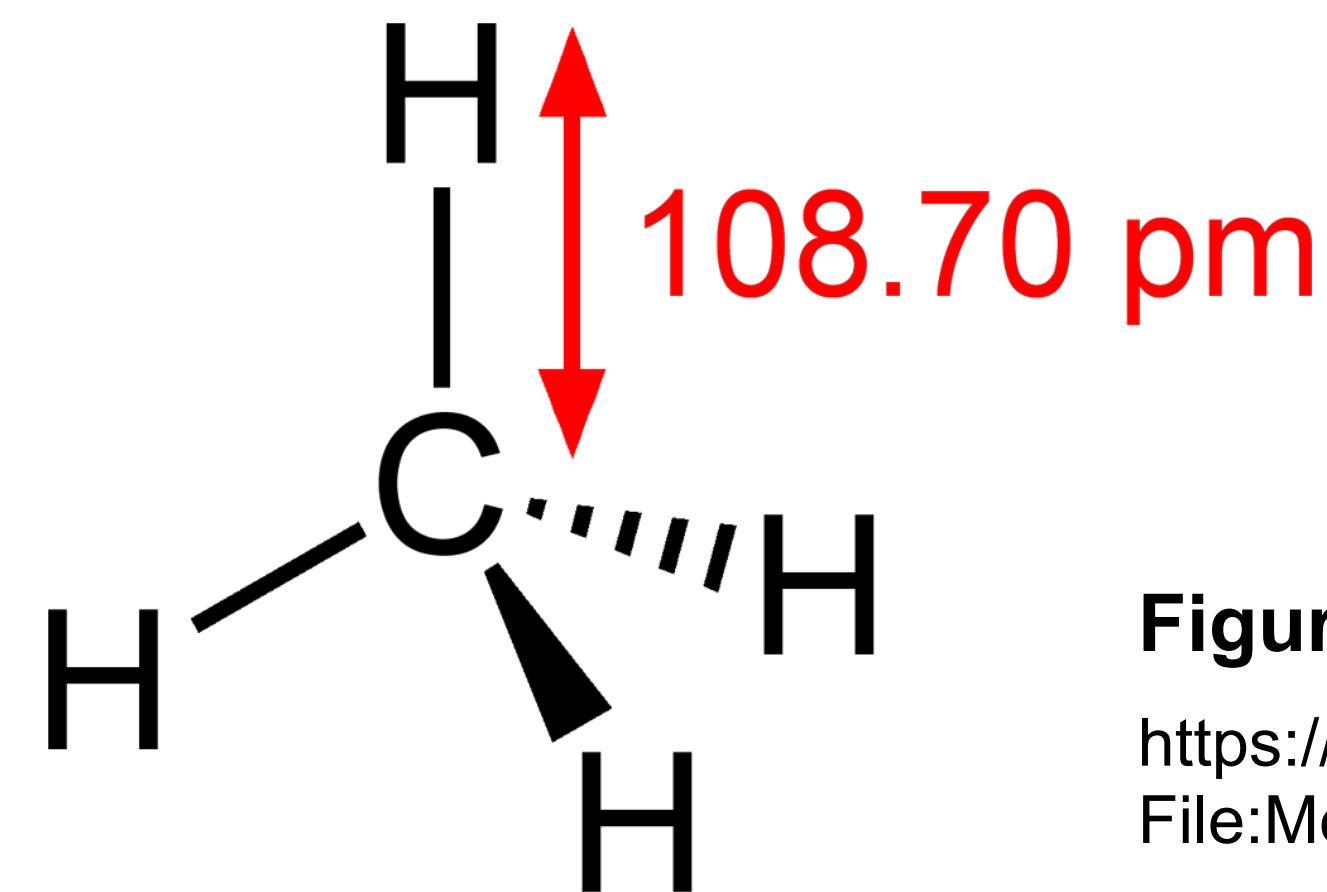


Figure 1

<https://commons.wikimedia.org/wiki/File:Methane-CRC-MW-dimensions-2D.png>

Methane (CH_4)

- Methane is a greenhouse gas (GHG) with the ability to retain a large amount of energy (figure 1).
- Though CH_4 does not last as long in the atmosphere as CO_2 , it has the potential to have a warming effect 25 times greater over a 100 year period due to its greater capacity to trap energy in the atmosphere.

Reservoirs

- As organic material flows into reservoirs and decomposes, it produces CH_4 .
- Given that the water level behind dams rises and falls with the seasons and rainfall patterns, new vegetation appears on the shoreline each year, which eventually becomes submerged around the rim of the reservoir.
- This fluctuation in water level and subsequent vegetation die-off provides a steady, prolonged method of methane production, persisting for the life of the reservoir.
- Researchers have found reservoirs with dendritic shapes to have a greater global warming potential, as their shoreline is far longer than more oval-shaped reservoirs (Keitel, Zak, & Hupfer, 2016).

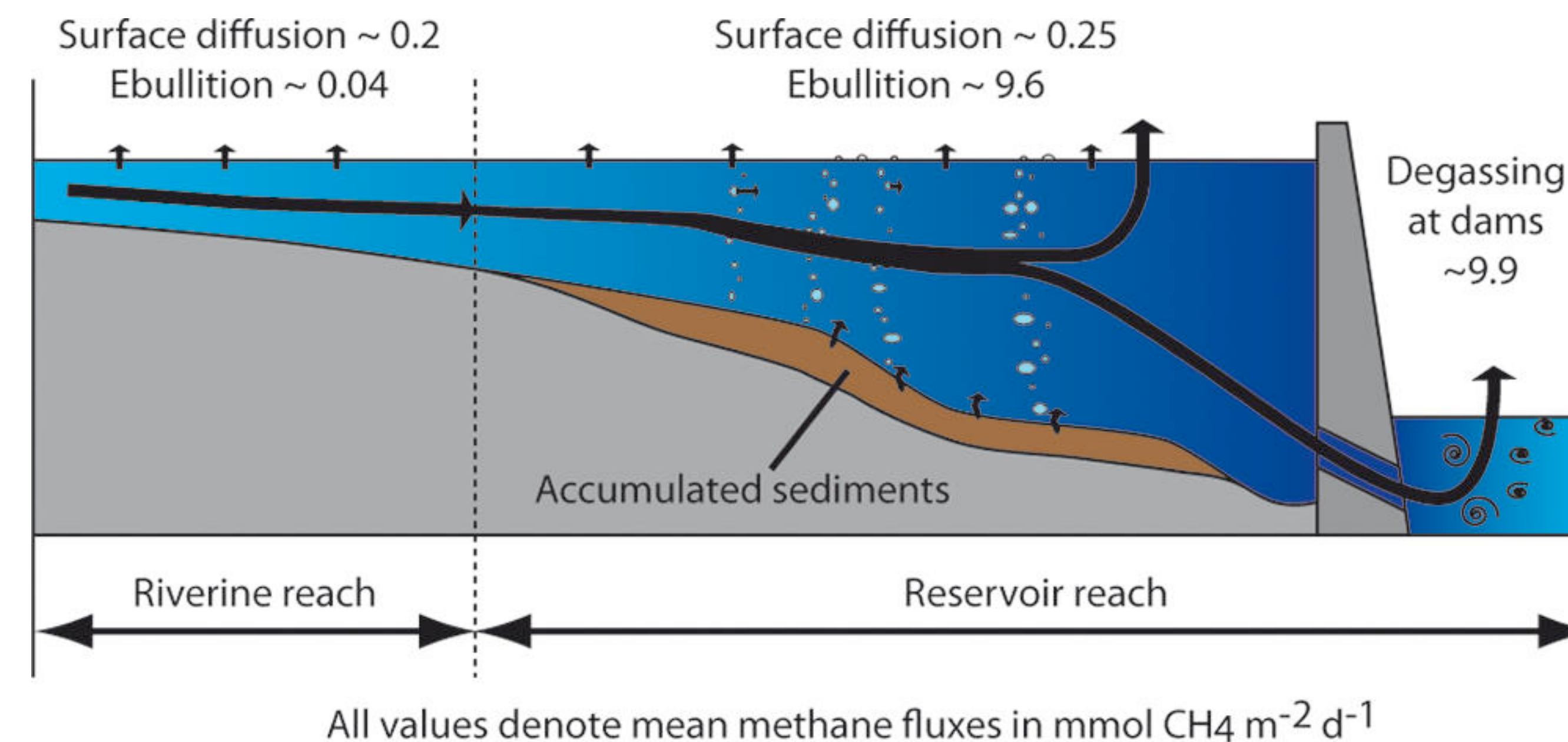


Figure 2 Environmental Science & Technology, 2013, 47(15), 8130–8137

Reservoirs (continued)

It is believed that methane is released from reservoirs into the atmosphere in three main ways (Maeck, et al., 2013) (figure 2):

1. Ebullition—occurs when methane bubbles build up beneath sediment layers underwater, gathering enough pressure to float to the surface.
2. Diffusion—occurs when gas in the river interacts with the air above it, releasing methane stored in the water.
3. Degassing—occurs when water that holds CH_4 passes through the turbines or spillways of the dam. This stirs up the water and releases the stored methane into the atmosphere.

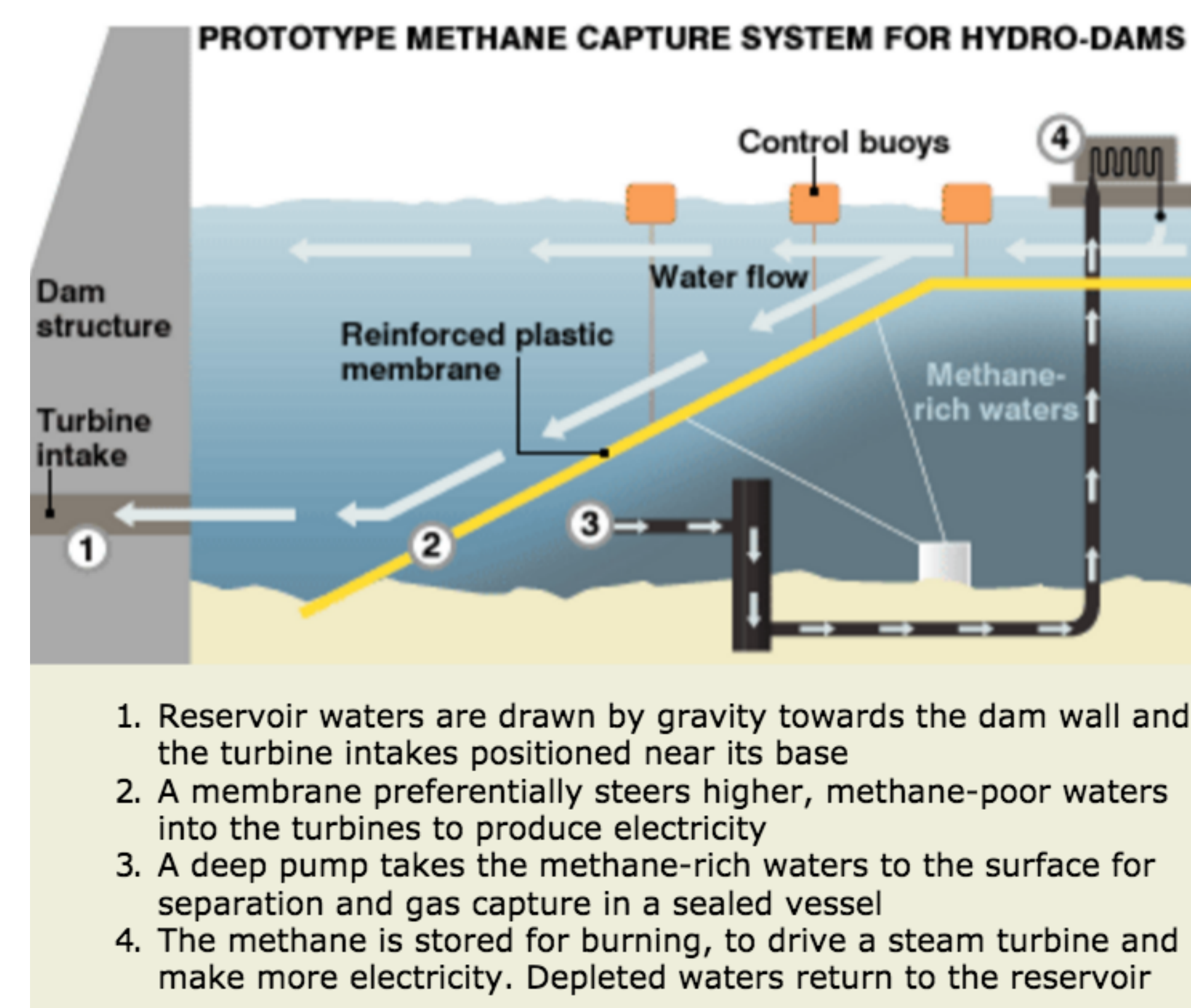


Figure 3 Hirsch, T. (2007, May 10). Project aims to extract dam methane. BBC.

Solutions

- Reduce dependence on dams in areas with large amounts of biomass inputs into rivers.
- Promote cleaner energy sources.
- Brazil's National Space Research Institute has proposed a prototype to capture the methane within a reservoir and use it for electricity production (Hirsch, 2007) (figure 3).

Conclusion

- Though hydroelectric dams do not directly put GHGs into the atmosphere, the amount of methane their reservoirs release is often enough to counterbalance the clean energy they produce.
- It is also clear that some hydroelectric dams have higher global warming potential than even energy derived from coal (Gunkel, 2009).
- This should not suggest, though, that coal or other fossil fuels are better alternatives to hydropower across the board.
- Instead, it should emphasize that hydropower should not be embraced as clean energy all over the globe.
- Energy production must rely on the local setting. The climate-related benefits of dams might offset their methane emissions in a given place, but this is not the case in many locations on the globe.
- In those areas, wind, solar, biofuels, or geothermal power may be the solution as finding sources of reliable and sustainable energy becomes more and more urgent.

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